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From October 1 through December 31, 1965, activity was concentrated on the selection of a curriculum and the development of topic objectives within each course of study. The proposed curriculum outlined for grades 9 through 14 is based on meeting the four identified domains of specific vocational, general vocational, citizenship, and self-fulfillment objectives. The specific vocational curriculum is to be prepared for each occupational area of interest to the Quincy Schools and is to specify "key" jobs at each of several levels and competencies required for qualification at each level. The general vocational curriculum areas implied are (1) commerce, industry, and occupations, (2) vocational guidance, and (3) basic technology. The citizenship curriculum phase emphasizes the family, local group membership, and local, state, and federal issues. The self-fulfillment curriculum contains elements of appreciation of American fiction, American history, and appreciation of the arts. While the broad course objectives describe levels of behavior required for effective use in life, the topic objectives are designed as unambiguous statements of student performance which identify the criteria of success and conditions under which performance is to take place. Curriculum implications, a review of practical problems encountered, and the rationale for topic objectives and procedures for deriving them are included. Other reports are available as VT 001 392-001 397, VT 004 848, and ED 013 318. (HC)

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THIRD QUARTERLY TECHNICAL REPORT

Project No. 5-0009

Contract No. OE-5-85-019

DEVELOPMENT AND EVALUATION OF AN EXPERIMENTAL CURRICULUM FOR THE NEW QUINCY (MASS.) VOCATIONAL-TECHNICAL SCHOOL

Curriculum Implications of the Study of Objectives

31 December 1965

U. S. DEPARTMENT OF
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Robert M. Gagné

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American Institutes for Research
Pittsburgh, Pennsylvania

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FOREWORD

This report, submitted in compliance with Article 3 of the contract, reports on technical activities of Project ABLE during its third quarter of operation, 1 October through 31 December 1965. A brief overview of the project is presented first, followed by a report summary. The major sections of the report concern (a) the curriculum implied by the preceding study of objectives and (b) the development of topic objectives. Plans for next quarter are outlined.

OVERVIEW: Project ABLE

A Joint Research Project of: Public Schools of Quincy, Massachusetts and American Institutes for Research

Title: DEVELOPMENT AND EVALUATION OF AN EXPERIMENTAL CURRICULUM FOR THE NEW QUINCY (MASS.) VOCATIONAL-TECHNICAL SCHOOL

Objectives: The principal goal of the project is to demonstrate increased effectiveness of instruction whose content is explicitly derived from analysis of desired behavior after graduation, and which, in addition, attempts to apply newly developed educational technology to the design, conduct, and evaluation of vocational education. Included in this new technology are methods of defining educational objectives, deriving topical content for courses, preparation of students in prerequisite knowledges and attitudes, individualizing instruction, measuring student achievement, and establishing a system for evaiuating program results in terms of outcomes following graduation.

Procedure: The procedure begins with the collection of vocational information for representative jobs in eleven different vocational areas. Analysis will then be made of the performances required for job execution, resulting in descriptions of essential classes of performance which need to be learned. On the basis of this information, a panel of educational and vocational scholars will develop recommended objectives for a vocational curriculum which incorporates the goals of (1) vocational competence; (2) responsible citizenship; and (3) individual self-fulfillment. A curriculum then will be designed in topic form to provide for comprehensiveness, and also for flexibility of coverage, for each of the vocational areas. Guidance programs and prerequisite instruction to prepare junior high students also will be designed. Selection of instructional materials, methods, and aids, and design of materials, when required, will also be undertaken. An important step will be the development of performance measures tied to the objectives of instruction. Methods of instruction will be devised to make possible individualized student progression and selection of alternative programs, and teacher-training materials will be developed to accomplish inservice teacher education of Quincy School Personnel. A plan will be developed for conducting program evaluation not only in terms of end-of-year examinations, but also in terms of continuing follow-up of outcomes after graduation.

Time Schedule: Begin 1 April 1965

Complete 31 March 1970

Present Contract to 30 June 1966

REPORT SUMMARY

During the present reporting period, the principal technical activity has been the selection of a curriculum and the development of topic objectives within each course of study. In prior months, work on objectives emphasized the development of comprehensive maps of the total set of objectives applicable to a vocational-technical curriculum for Quincy. Once the domains of educational objectives were mapped, the task became one of selecting specific objectives for the curriculum from the very large number available. When the curriculum had been selected and planned, objectives for topics within the curriculum could be defined. This report summarizes the curriculum implications of our study of objectives, outlines a curriculum for the vocational-technical school, discusses the rationale of topic objectives and the procedures for deriving them, and reviews the major practical problems encountered.

During the next quarter, derivation of topic objectives will continue, development of instructional materials, methods, aids and procedures will begin, and detailed plans for the Junior High guidance program will be completed.

INTRODUCTION

The principal goal of Project ABLE is to evaluate the effectiveness of instruction (a) for which the content is derived explicitly from analysis of the behavior desired of graduates, and (b) which results from the application of new educational technology in its design, conduct, and evaluation. The goal for the curriculum is considered comprehensive since it includes provision for development of the skills and knowledges essential to responsible citizenship and to self-fulfillment as well as to vocational satisfaction.

Since initiation of Project ABLE, the staff has been conducting a study addressed to the problem of defining objectives for the curriculum. The derivation of objectives has been based upon systematic identification and description of the jobs in the occupational areas of concern to the Quincy schools, and upon the findings of other studies and analyses. The procedures and rationales for this work have been reviewed in two previous technical reports by the project (American Institutes for Research, 1965a, 1965b). The objectives so far derived have been discussed with the project's Advisory Panel, who have made a number of recommendations about them.

Initially, the task of stating objectives is one that uses the criterion of comprehensiveness. At the beginning, one is not primarily so concerned with the objectives of particular courses in particular schools as he is with insuring that there is a fully adequate "map" of the total domain of educational objectives in the areas of concern to the project. We have tried to develop comprehensive maps of the total set of objectives applicable to a curriculum for the new Quincy Vocational-Technical School.

Once the domains have been mapped, however, the task becomes one of selecting objectives for the curriculum from the very large number available. Any curriculum plan must be highly selective. From the extensive domain of educational objectives, selection of specific objectives must be made both

among different areas and within them. The need for selection, and the extent of it, becomes quite apparent when one examines the large number of specific jobs that exist within any one occupational field such as electrical-electronic trades. Selection is clearly required when one examines a domain like that of citizenship, which extends from humble and ubiquitous activities like providing for children's education, to the relatively complex decisions involved in establishing a business partnership, or initiating a petition for recall of a state official.

A major next step for the project, then, is selecting a curriculum, and making a plan for it. The first major section of this report outlines and discusses the curriculum which seems implied by our study of objectives.

Once a curriculum has been selected and objectives have been defined for the courses of study, it is necessary to define topic objectives for each course of study. The purpose of topic objectives, the procedures employed for specifying them, and some problems encountered by the staff in preparing them are reviewed in the second major section of this report.

CURRICULUM IMPLICATIONS OF THE STUDY OF OBJECTIVES[1]

Before proceeding to a description of the curriculum selections, it will be useful first to review the nature and scope of the domains of objectives we have formulated, and from which selection will be made.

Four Domains of Educational Objectives

As described in the Second Quarterly Technical Report (American Institutes for Research, 1965b), four major areas of educational objectives seem appropriate for meeting the goals on which the project is based. These are (a) specific vocational objectives; (b) general vocational objectives; (c) citizenship objectives; and (d) self-fulfillment objectives. These classes are not entirely distinct from each other--there are overlapping objectives in the expected places. The status of each of these domains is summarized in the following paragraphs.

Specific Vocational Objectives

First of all, there are a number of different jobs within each occupational area. These may readily be arranged into levels, as determined by a number of factors including the amount of shop training typically required, the hierarchical arrangement of component skills, and apprenticeship requirements established by trade unions. Sometimes there are a great many specialties at a particular level, sometimes only a few. It seems reasonable, though, that vocational education could be arranged to make it possible for

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[1] This section was prepared originally by Dr. R. M. Gagné as a project working paper intended to summarize the consensus of the project staff, the Advisory Panel, and the Quincy school leadership. After much discussion, it remains, essentially unchanged, an accurate statement of that consensus.

different individuals to "finish," or "get off" at different levels. In most occupational areas, even the lowest-level job makes good sense, although it must be borne in mind that employment at this level may be difficult in some cases, because of customs and laws.

Each of these "level-determining" jobs has been described in terms of its component tasks. Such descriptions are expected to be useful in three subsequent phases of the project's work, as follows: (a) review of content of specific vocational instruction in various occupational areas; (b) derivation of generalized content in such related subjects as mathematics, science; and (c) design of performance measures for particular objectives.

General Vocational Objectives

This domain of objectives has been derived primarily from analyses conducted in two other AIR projects. They have been described in the broad categories of knowledge pertaining to (a) choosing a career; (b) forging a career; and (c) demonstrating basic vocational skills. It is evident that these general knowledges are intended to aid the individual in estimating his own capabilities, and also in surveying the occupational possibilities available to him. Additionally, they include such areas as work habits and attitudes, and certain basic forms of adjustment to the work situation. Finally, they include a number of very important knowledges that are general to a variety of occupations, which may be called "technological knowledge."

The significance of various components of this domain for other phases of the project may be viewed as follows:

1. Certain of these objectives may legitimately be classified in the "social studies" area. These pertain to such components as the nature of occupations, salaries, progression, mobility, labor-management relations, as well as certain vocational skills and work habits.

2. Some of the objectives are normally considered a part of "guidance." This is true of knowledge of the individual's

own abilities and interests, and other information contributing to self-knowledge and self-development.

3. A large segment of these objectives is composed of "technological knowledge," which is normally included in the curriculum in only the most piecemeal fashion. This knowledge is made up of principles pertaining to machines, materials, chemicals, electrical functions, spatial relations, symbols, and interpersonal relations.

Citizenship Objectives

Analysis of the activities of the adult as a responsible citizen has led to the identification of three major dimensions of the domain of citizenship objectives. When such activities are considered as a whole, they obviously constitute a very large domain of potential activities from which selection must be made. The important dimensions may be described as follows:

1. Classes of human social activity, describable in the three principal categories of (a) participating in the formal operations of society; (b) facilitating and augmenting societal operations; and (c) working to achieve social change.

2. Kinds of societal goals toward which the activities of the individual are directed. Such activities, for example, may at one time or another be primarily directed at the societal goals of safety and health, education, economic welfare, defense, or others.

3. The societal unit whose operations provide the target of the individual's activity. One thinks first of the family as an entity which might be such a target. Others are political, social, or business "clubs," local, state, and national governments, or even world organizations like those of the United Nations.

The problem of selection is obviously one of establishing priorities in this vast area of knowledge called citizenship. On the basis of probability of occurrence of the activities, the dimension of the societal unit obviously provides the greatest source of variation. Certain actions with respect to the family are highly probable (and therefore of great importance), whereas actions having significance for the nation are likely to be quite limited in number and variety.

Self-Fulfillment Objectives

This is the area of appreciation, and therefore of life enjoyment. It is a very broad area, and must encompass activities ranging from drinking beer in a tavern through athletic participation to the enrichment of life by means of aesthetic experience, say, of music. Its cognitive aspects in the human being are rich and varied, and imply a special importance to those aesthetic media using language. These include the enjoyment of literature including history, plays, motion pictures, radio, and television.

There appear to be many different ways to dimensionalize and describe this domain. For example, the Second Quarterly Technical Report of the project (American Institutes for Research, 1965b) suggests the dimensions of (a) participation-observation; (b) sensory-cognitive, and (c) individual-social. A domain constructed on these dimensions provides some important illuminations. However, the variety of self-fulfillment activities is so vast that selection remains a difficult problem.

A reasonable goal for education in this area would seem to be making it possible for the student to acquire the minimal knowledges and skills to engage in self-fulfilling activities (in addition to the pursuit of his main occupation) that (a) contain potentialities for self-development, and (b) are of sufficient variety to partake of both physical, cognitive components and different degrees of social involvement. It is recognized that the school cannot take all of the responsibility for such development, even if one takes account of the school's athletic and extra-curricular programs.

The forward-looking implications of selection from this domain may be summarized as follows:

1. Objectives need to contain a reasonably adequate representation of literature and the drama of history. For the individual adult, such activities may be reflected by his reading, watching movies or television, listening to radio, attending the theater.

2. Provision should be made for opportunities for the individual to increase his appreciation of music and visual art.

3. Opportunities should be provided for development of athletic skills and appreciations.

4. There should be opportunities for development of individual skills that may be involved in hobbies, games, and other forms of recreation.

Representation in the Curriculum

Having described the domains from which our curriculum is to be drawn, we may now proceed to draw the more specific implications and to make the selections which will yield a curriculum plan. This will be done first by describing some important prerequisites, and then by reference to the four domains of objectives previously described.

Prerequisites

Adequate preparation must be made in the ninth grade for the establishment of knowledges and attitudes that will make it possible for the student to take advantage of the various areas of the high-school curriculum. One important portion of these prerequisites is basic skills, including both verbal and numerical "literacy." A second and highly important segment pertains to background knowledge (social studies) about the world of work and

occupations. Related to this knowledge, systematic information needs to be transmitted to the student concerning his own individual talents and interests. Preferably, a plan approved by parents should be attained before the end of the ninth grade in which a tentative commitment is made to a college-bound vs. a non-college-bound career.

The kind of content which may need to be partially covered as a prerequisite in the ninth grade is described in a later section under "Curriculum for General Vocational Skills."

Curriculum for Specific Vocational Capabilities

The plan for such a curriculum should be drawn up for each occupational area of interest to the Quincy schools. It should specify "key" jobs at each of several levels, and should then describe the sub-objectives considered to be required for qualification at each level. An outline of what is intended here, for a portion of one occupational area, is as follows:

GRAPHIC ARTS

A. Commercial Arts

Level 1 - Letterer, Inker

1.

2. etc.

Level 2 - Artist Retoucher, Colorer

1.

2. etc.

Level 3 - Advertising Layout Man

1.

2. etc.

Level 4 - Sign Letterer

1. Makes accurate and correct recording of client's directions
2. Organizes composition of sign, using design principles
3. Makes copy and title compatible with illustration
4. Lays out full size "rough" rendering
5. etc.

Needless to say, the tasks specified under each key job should be of sufficient clarity and specificity that a reasonable measure of what constitutes adequate performance is immediately apparent.

The jobs specified as key jobs are those for which completion of requirements can be certified for any student who demonstrates competence. At the same time, they should represent the kinds of capabilities which can reasonably be fitted to job categories, that is, to real potential employment opportunities.

Curriculum for General Vocational Skills

In this area, we are faced with what appears to be both scattered and spotty representation of the objectives within currently existing school programs. Mainly, the problem is to draw together these objectives as represented in a variety of existing topics and courses, so that they form coherent entities for the curriculum. Three major curriculum areas appear to be implied:

1. Commerce, Industry, and Occupations. This area of the curriculum needs to concern itself with imparting basic knowledge about how the "economic" affairs of our society are conducted, including particularly how natural resources are utilized, how goods are produced, how money is employed, etc. It should proceed to a consideration of occupations, jobs, and employment. Included in this should be the following kinds of knowledge:
   a. The economic bases of society: agriculture, industry, commerce, etc.
   b. The origins and structure of modern economic institutions
   c. The sources of occupations
   d. The varieties of work and occupations
   e. How prices and wages are determined
   f. Business, government, and labor
   g. The nature of work--professions and jobs

h. Education and training requirements
i. Job advancement--careers
j. Job satisfactions and dissatisfactions
k. Supervision and its relation to the worker
l. Employment procedures
m. Automation and occupational change
n. Work and leisure

It seems evident that this kind of content could well be encompassed under the heading of social studies, should it be desirable to maintain traditional labels for the curriculum.

2. Vocational Guidance. First of all, this area of the curriculum should provide the student with the opportunity of obtaining all the occupational knowledge he needs or wants, in a truly individualized manner. Not everyone is interested in becoming a carpenter, but those who are should be able to learn what a carpenter does, what his employment is like, how he has prepared himself, what his prospects are, and so on. Then, each student should be given sensible, understandable information about himself, his interests, achievements, and capabilities. Discussion sessions with the vocational counselor should ensue, to achieve a "match" which is considered sensible to both, but which is always open to change. These requirements indicate the need for the following kinds of content:

a. Occupational information--Probably the most convenient form would be film or slides with sound accompaniment, perhaps of 15 minutes in length. Depicted and described would be what an individual does in a job. The jobs represented should be at least all of the "key" jobs in the Quincy vocational curriculum.

b. Personal information--To aid the student in making an occupational decision, he needs to be given information about (1) his aptitudes, and (2) his pattern of interests. The former might well be obtained by using certain key tests of Project TALENT. This is particularly important since this project is in the process of validating aptitude patterns based on these tests. Patterns of interest are best indicated, apparently, by tests of "General Information," as well as by "Activity Inventories." Current evidence indicates that "Interest Blanks" are quite useless. Accordingly, aptitude and interest information of the sort known to be useful should be obtained for every student, and cast in a form which can make most sense to him.

c. Counseling interview--Available to the counselor should be other background information on the student, concerning his family, their economic status, etc., as well as the student's academic record. There should be at least one rather extensive interview (or discussion) per year for each student, with the understanding that additional interviews may be requested by the student.

3. Basic Technology. This area of the curriculum represents one of the most important portions of the student's general education. It should be required for all students, but preferably on an individualized basis. Its areas of content follow. Some of them can only be indicated sketchily at the present time.

a. Machines and Mechanical Principles

(1) The simple machines--levers, pulleys, screws

(2) Analysis of hand tools in terms of the principles of simple machines

(3) Analysis of common stationary machines and structures

(4) Connections and fittings in relation to mechanical principles

(5) Vehicular motion

(6) Hydraulic principles and their application to machines

(7) Aerodynamic principles and their application to machines

(8) Structures of materials

(9) Properties of materials

(10) Expansion and contraction of solids

(11) Optical phenomena, and their relation to lens components

b. Electrical, Electro-Mechanical, and Electronic Principles

(1) The concept of electric force

(2) Varieties of electric force in common devices

(3) Etc.

c. Applied Geometry of Solids and Structures

(1) Representation of points, lines, and surfaces

(2) Analysis of structures in terms of points, lines, planes

(3) Solids and their representation

(4) Etc.

d. Chemical Components and Reactions

(1) States of matter--solids, liquids, gases.

(2) Analysis of common materials in terms of their states

(3) The structure of matter in common solids and liquids

(4) Chemical reactivity

(5) Etc., including the chemistry of the body, the chemistry of foods

e. Verbal Communication

(1) Functions of words in sentences

(2) Varieties of sentences

(3) Practice in oral communication with sentences
(4) Writing sentences
(5) Expression of ideas in written sentences
(6) Word recognition in reading
(7) Rapid reading of sentences
(8) Understanding instructions
(9) Report writing
(10) Etc.

f. Numerical Communication
(1) Basic arithmetic operations
(2) Practice in short-response arithmetic operations
(3) Fractions
(4) Decimals, percentage
(5) Application to practical problems
(6) Measurement fundamentals
(7) Use of common measuring instruments
(8) Tables and graphs
(9) Etc.

g. Human Relations
(1) Influencing behavior of others
(2) Conventions in inter-personal relations
(3) Providing service to other people
(4) Persuasion
(5) Etc.

Curriculum implications of basic technology. It is apparent that this area of curriculum represents a fairly extensive mass of content material. Some of it can probably best be handled within existing courses, while other portions appear to require separate offerings for most effective treatment. The implications for modification of the traditional curriculum appear to be as follows:

a. Machines and Mechanical Principles: Separate course. Not the kind of material considered proper for modern courses in physics.

b. Electrical, Electro-Mechanical, Electronic Principles: Separate course. Not usually included in a course in physics.

c. Applied Geometry of Solids and Structures: This is a combination of geometry and mechanical drawing. It is not proper for geometry, however, because of its applied nature. Could be mechanical drawing, with an intellectualized content.

d. Chemical Components and Reactions: While some of this could be included in chemistry, it is probably best a separate course because of its applied nature.

e. Verbal Communication: Seems best handled in English.

f. Numerical Communication: Seems best handled in mathematics.

g. Human Relations: The need for new course material is severe.

Curriculum for Responsible Citizenship

It is believed that the selection of content in this area should emphasize the highly probable decisions and responsibilities to be taken by an adult with a job and family. Generally speaking, this means that emphasis should probably be on the family, on local group membership, on local issues, state issues, and federal issues, in that order. A problem orientation seems desirable, in view of the fact that objectives emphasize the making of responsible decisions. However, the fact that such decisions must be based on solid information cannot be overlooked. The barest outline of content can be indicated as follows:

The citizen in modern society

a. The origins and structure of the family

b. The family in the United States

c. Decisions affecting the family:
    (1) Individual liberties
    (2) Safety and health
    (3) Education
    (4) Economic welfare and development
    (5) Cultural and social development
    (6) Improving the physical environment
    (7) Maintaining law and order
    (8) Maintaining the family as an institution
d. The process of family decision-making
e. Membership in organizations (unions, service clubs, etc.)
f. The process of action in groups
g. The local government:
    (1) Individual liberties
    (2) Safety and health
    (3) Education
    (4) Economic welfare and development
    (5) Cultural and social development
    (6) Improving the physical environment
    (7) Maintaining law and order
    (8) Maintaining the government
h. Participating in decisions affecting local government
i. The state government and its societal functions
j. Participating in decisions affecting state government
k. The Federal Government's operations
l. The Federal Government's functions
m. Participating in decisions affecting National Government
n. The United States and its relations with other countries of the world

The major implications of this analysis appear to be as follows: There is need for a course emphasizing the knowledge necessary for making wise decisions by the adult citizen. Its content should realistically reflect the

working adult's concern with decisions affecting the family, membership in local organizations, local government, state government, federal government, and international relations in that order of emphasis. A course in American Democracy might well have this emphasis.

Curriculum for Self-Fulfillment

No single approach can be taken for this area of the curriculum. The existence of extra-curricular activities including athletics, orchestra or band, and hobby clubs undoubtedly represents part of the answer. In all probability, the curriculum should contain elements of the following content, in some cases as elective courses and in others as part of traditional courses:

1. Appreciation of American Fiction. A realistic attempt should be made, probably in English courses, to develop improved understanding of the intellectual content of fictional prose and poetry, beginning with elementary stories of adventure, science fiction, etc.

2. American History. Emphasis might be placed on the story of history as a set of dramatic events. (History is sometimes written this way.) This means that there would not be a major emphasis on political events, although they would be included. The major purpose should be to provide a deeper understanding by the individual of his relation to his culture--how he got that way, in a historical sense. This is conceived as a required course.

3. Appreciation of Visual Art

4. Appreciation of Music

5. Appreciation of Movies and Television

Proposed Curriculum

Grade 9	Periods
Social Studies (industries and occupations)	5
Vocational Guidance	Various
Other Subjects	35
Physical Fitness	( )
	40

Grade 10	
Specific Vocational (shop or laboratory)	15
Fundamentals of Technology (individualized, shop related)	5
Mathematics (numerical communication)	5
English (communication; literature)	5
Social Studies (economics and sociology of industry, occupations)	5
Physical Fitness	( )
Elective	5
Vocational Guidance	Various
	40

Grade 11	
Specific Vocational (shop or laboratory)	15
Fundamentals of technology (individualized, shop related)	5
Mathematics (numerical communication, including trigonometry)	5
Science (applied human physiology)	5
English (communication, literature)	5
Physical Fitness	( )
Elective	5
Vocational Guidance	Various
	40

Grade 12	Periods
Specific Vocational (shop or laboratory)	15
Fundamentals of Technology (individualized, shop related)	5
Social Studies (American history, citizen in modern society)	5
Science (physics, chemistry)	5
English (communication, literature)	5
Physical Fitness	( )
Elective	5
Vocational Guidance	Various
	40

Grade 13	
Specific Vocational	15
Electives (adapted to specific programs)	
Social Studies--American Institutions	5
Mechanical Drafting	5
Technological Processes in Industry	5
Engineering Mathematics	5
Technical Report Writing	5
Science	5
Physical Fitness	( )
Others	5
To Make	40

Grade 14	
Specific Vocational	15
Electives (adapted to specific programs)	
Social Studies - Organizations, Supervision	5
Machine Design	5
Mathematics, advanced	5
Science	5
Public Speaking	5
Physical Fitness	( )
Others	5
To Make	40

TOPIC OBJECTIVES

As indicated previously, Project ABLE has concentrated in past months on the derivation of specific objectives for each course of study. Course objectives have been prepared which define the capabilities of the successful student. That is, they describe the kinds of things the graduate can do and, in that sense, are a description of the end-product of education. Selection and definition of course objectives mark an important milestone en route to the curriculum for they establish the decisions as to what this particular curriculum is intended to accomplish. These decisions make it possible to turn to the development of learning regimens through which students acquire the capabilities needed to satisfy course objectives. The derivation of topic objectives is the first step in that development.

Hierarchies of Capabilities

Course objectives describe a level of behavior which is required for effective use in life. The performance described by a course objective is a behavior which can be valued in and of itself. Examples of behaviors suitable for definition as course objectives are: repairs a carburetor; translates into English a paragraph from a French newspaper. Such behaviors are complex in the sense that their accomplishment requires that other capabilities be learned first. Thus, the attainment of a course objective is a matter of successive attainment and integration of a series of lower-level capabilities (cf. Gagné and Paradise, 1961; Gagné, 1962).

A learning structure or hierarchy may be identified for each course objective. At the top of the hierarchy is the course objective. Immediately below are those capabilities which must be assumed if the student is to attain the objective under a single set of learning conditions. Each of the capabilities immediately prerequisite to the course objective also

has prerequisite, and so on. A learner achieves the capability to perform the class of tasks defined by the course objective by working his way up through the hierarchy of subordinate capabilities, beginning wherever his previous learning places him in the hierarchy. Capabilities within the hierarchy then become learning units or topics to be mastered in the sequence defined by the hierarchy. The statement of performance identifying each capability is a topic objective. Each topic objective is an unambiguous statement of student performance which identifies the criteria of success and the important conditions under which performance is to take place.

Topic objectives in this hierarchy serve several purposes which are summarized below:

1. They identify the capabilities which must be acquired to attain the course objective.
2. They define learning units which are relevant to the course objective and, therefore, are related systematically to the general goals of the curriculum.
3. They define an effective sequence for learning.
4. They provide a basis for assessing each student's achievement at any stage in terms which are diagnostic of his learning needs.
5. They provide the student with specific information about what is expected of him.

We turn now to procedures used in Project ABLE for deriving topic objectives.

Derivation Procedures

The general procedure for deriving topic objectives is essentially the same as the procedure described and illustrated in the Second Quarterly Technical Report (American Institutes for Research, 1965b) for development

of the structure relating objectives to general educational goals. The analysis begins by asking for each course objective, "What capabilities must be assumed if the student is to learn this capability under a single set of learning conditions?" The answer to this question identifies a set of subordinate capabilities which are simpler and more general than the course objective. The same question then is asked about each of the new capabilities and another level of capabilities is identified. This process continues until the capabilities identified are within the repertoire of every student. The application of this general procedure in Project ABLE, can be illustrated by a description of the work on topic objectives for the vocational subject areas.

Objectives are being prepared in each vocational area by members of the Quincy Trade School faculty. Each faculty member is a specialist in the vocational area to which he is assigned on the project. None of the faculty members had experience with the kind of analysis required here prior to joining the project. However, each had developed the course objectives for his vocational area, had examined project quarterly reports, and had attended a presentation by Dr. Gagné summarizing his book, The Conditions of Learning (Gagné, 1965).

The work on topic objectives was introduced in a series of short meetings which covered: the purposes to be served by the objectives, the relation between the objectives and the types or conditions of learning, the format and characteristics required for satisfactory statement of objectives, and a demonstration of the process of defining a hierarchy of objectives using a fictitious example. Instructions given for deriving objectives may be summarized as follows:

1. Take one of the selected jobs, preferably at the higher skill level, and start with the first course objective in that job.
2. For this course objective, ask yourself the question, "What kinds of previously learned capabilities need to

be assumed if the person is to learn <u>this</u> capability under a single set of learning conditions?"

3. Write one or more topic objectives for the capabilities so identified. Be sure these objectives contain an action verb (as contrasted with words like knows, understands). State the condition of performance and include a basis for evaluating performance.

4. For each topic objective in turn, ask yourself the question again and, for the behavioral capabilities you identify, write another set of topic objectives.

5. Repeat this process until you reach the level of capability that even the lowest level student would possess.

6. When you complete this for the first course objective, proceed to the next course objective.

The specialists then began individually to work on objectives. As expected, they had considerable difficulty and a second set of meetings was used to identify problems and work out solutions. Some of the persistent problems are discussed in the next section of this report, but it should be pointed out here that some difficulties were generated by the nature of the subject matter and by the structure of jobs within an area. The vocational areas vary with respect to the ease with which capabilities can be analyzed. Gradually, solutions to the problems were devised by the specialists and the research staff working together closely and continuously, and the quality and quantity of objectives reached acceptable levels.

We shall review next some of the problems encountered in deriving topic objectives since this review might be useful to others who undertake a similar task.

Problems Encountered

Initially, it was intended that each topic objective would be related to one of the eight types of learning (Gagné, 1965). A form (Appendix A) was designed which included a restatement of the course objective, previously written as part of the job analysis, a statement of the associated topic objectives, and a coded entry indicating the type of learning involved in each objective. It became evident almost immediately that identifying capabilities as a hierarchy of learning sets and relating these to kinds of learning required an unacceptable amount of time. Consequently, specialists were asked only to identify the capabilities desired in students and to translate these into objectives. Analysis of the kinds of learning required by each objective was postponed until the curriculum content phase of the project where sequencing of material becomes critical.

Most specialists had difficulty with the level of specificity in course and topic objectives. For course objectives which were broad or general in nature, the quantity and levels of topic objectives were numerous. For an occasional course objective, it was difficult to identify more than a single prior capability. The specialists wanted a concrete point of reference on specificity which they could apply universally. From a practical point of view, the solution had to be found in the context of their own course objectives, classroom-shop experiences, and skill in delineating relevant performance capabilities at successive levels. Rather than rework course objectives, it was decided that topic objectives would be prepared as necessary, even though some might not be clearly implied in the existing statements of course objectives. Corrections to course objectives can be made later.

In some vocational areas, a particular course objective was found to occur in several jobs. For example, in the Machines family of the Metals and Machines area, nearly every selected job had at least one course objective concerned with use of precision measuring instruments during a machining process. In the Pattern Making family of the General Woodworking area, print reading was contained in a number of course objectives. Such

instances are examples of general technical skills. In our analysis, "recurring capabilities" were stated as objectives only once and then simply referenced in all other occurrences. Capabilities required in use of measuring instruments (Machines), for example, were defined as a single course objective. Any other objective for a specific job in the Metals and Machines family which is concerned with these measurement tools is cross-referenced to the measurement objective.

Project ABLE experience has been that preparation of adequate topic objectives requires the cooperative efforts of a vocational specialist and a research specialist. The research person does not know the requirements of occupations sufficiently well to develop objectives unaided. The vocational specialist is not sufficiently experienced with the analysis of behavior to proceed alone. Thus, the vocational specialists were able to identify the many tasks required in the occupations for which they were responsible, but the assistance of a research person was needed in order to identify the skills and knowledges critical for performance of each task. Similarly, the vocational specialists were able to describe the sequence in which the elements of a task should be performed, but required the assistance of a research specialist to define the performance objective of the task. The successful development of topic objectives has depended, in Project ABLE, upon this interdisciplinary team arrangement.

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PLANS FOR NEXT QUARTER

The following activities are planned for the quarter ending 31 March 1966:

1. The derivation of topic objectives will continue.
2. Selection of instructional materials, methods, and aids will begin.
3. Development of instructional procedures will begin.
4. Detailed plans for the Junior High guidance program will be completed.
5. Development of the Junior High guidance program materials will begin.
6. Development of objectives in mathematics and social studies will continue.

APPENDIX A. TOPIC OBJECTIVES: RECORDING FORM

APPENDIX A

TOPIC OBJECTIVES

VOCATIONAL AREA: COORDINATOR:

SUB FAMILY: DATE:

SELECTED JOB TITLE: TASK NO:

STATEMENT OF COURSE OBJECTIVE:

APPENDIX A (cont.)

TOPIC OBJECTIVES

SELECTED JOB TITLE:

CODE: Signal - Si; Stimulus-Response - SR; Chaining - Ch; Verbal Association - VA; Multiple Discrimination - MD; Concept - Co; Principle - Pr; Problem Solving - PS

NUMBER	TYPE OF LEARNING	